d. Remarks

OBVIOUSNESS REJECTIONS

1. At page 2, the Office Action rejects claims 1 – 2, 4 – 10 and 13 – 19 as obvious over a combination of U.S. patent application publ. 2002/0181059 ('Christopher'), U.S. patent 4,009,385 ('Sell'), and an article of Paiella et al, published at Appl. Phys. Lett., Vol. 75, No. 17 (Oct. 1999) pages 2536 – 2538 ('Paiella').

While Christopher is a publication of a patent application filed Nov. 7, 2001, the pending application claims priority to provisional application No. 60/263,256 ('256), which was filed earlier and supports the pending claims. For that reason, Applicants assume that the rejection relies on Christopher only for matter supported by yet earlier filed provisional application 60/246643 ('643) to which Christopher claims priority.

The Office Action relies on a combination of Christopher and Paiella to teach directly modulating a mid-infrared laser and transmitting light from the modulated laser as in pending claim 1 and to teach a mid-infrared laser and a modulator to directly modulate the laser as in pending claim 13. With respect to motivation to modify Christopher to incorporate teachings of Paiella therein, the Office Action states:

> One of ordinary skill in the [sic] would have been motivated to combine the teaching of Paiella et al. with the free space communication system of Christopher because it is compact and power efficient in comparison with traditional mid-infrared source, such as CO_2 laser. Thus it would have been obvious ... to use a direct modulation of a QC laser, as taught by Paiella et al., as the light source in the free space communication system of Christopher because QC laser is compact and power efficient in comparison with traditional mid-infrared source, such as CO_2 laser.

Office Action, paragraph bridging pages 2 and 3.

Applicants do not find the above-stated motivation to modify in either Christopher's '643 provisional application or Paiella. For example, Christopher's '643 provisional application states:

> University of Vienna presentations at September 2000 CLEO conference in Europe have shown consistently reliable solid state lasers at 11 microns.

'643 provisional application, page 14.

Thus, Christopher already suggests using solid state lasers as mid-infrared sources. One of skill in the art would not have expected that substituting Paiella's QC laser systems in

Christopher's systems would have been more advantageous, because Christopher already teaches using solid-state lasers. Also, properties of CO_2 lasers are irrelevant, because Christopher's '643 application already describes using solid-state laser systems, which the Office Action admits are compact and power efficient. Thus, the Office Action has not provided grounds to motivate modifying Christopher to incorporate the gain-switched laser systems of Paiella therein.

In addition, Paiella discloses two facts that would have suggested to one of skill in the art that his QC laser systems were neither compact nor power efficient.

First, Paiella states that "[t]he maximum operating temperature of his gain-switched sources is approximately 120 K", i.e., about -153°C. Paiella, abstract. To produce such low temperatures, Paiella discloses using special and complex "packaging of the QC lasers" that includes mounting the lasers "inside a cold-finger helium-flow cryostat". Paiella, page 2536, right column, last paragraph. Thus, Paiella teaches that his laser sources need a cryostat or other cooling device to enable gain switching. Since Paiella teaches systems that include both a QC laser and a cryostat, he suggested that such systems would be both much bulkier and more complex than typical solid-state lasers. Thus, the teachings of Paiella would have suggested to one of skill in the art that his laser systems were less compact than traditional solid-state lasers. For that reason, Paiella's disclosure does not support the Office Action's statement that his systems are "compact" compared to traditional mid-infrared sources and thus, would have motivated replacement of Christopher's lasers. Instead, Paiella's teachings on the sizes and complexity of his systems would have discouraged substituting his gain-switched laser system for the lasers Christopher suggested for use in his satellite-ground optical communication systems.

Second, Paiella discloses facts suggesting that his gain-switched QC laser systems lack power efficiency. In particular, Paiella discloses that gain-switched operation of his QC lasers produces a "multimode" output rather than a single-mode output. He states:

> [I]n Fig. 3 we show the spectrum of a gain-switched QC laser .... While this device emits in a single longitudinal mode when operated cw, it becomes multimode under gain switching. This is the result of the initial overshoot of the population inversion following each electrical driving pulse, ...

Paiella, page 2537, right column, first full paragraph.

Paiella's Fig. 3b shows a multimode optical spectrum produced during gain-switched operation. In the multimode spectrum, the optical energy is spread over many frequency peaks, which are themselves spread over a much wider band than in the spectrum of the same laser when operated in continuous wave (cw) mode (see Fig. 3a). Thus, Paiella's Figs. 3a and 3b would have suggested that standard external modulation of the QC laser in cw mode would have more efficiently used optical power than gain-switched modulation of the same QC laser. In particular, in the gain-switched mode, the optical energy is spread over many peaks whereas a receiver would typically demodulate transmitted data from only one or a few of said peaks. The optical power that gain-switched operation produces in other the other peaks would thus, be wasted. Fig. 3B suggests that the wasted optical power can correspond to a large part of the total optical power. In contrast, Figs. 3a – 3b suggest that external modulation of the same laser in cw mode would not have spread the total optical over so many peaks and thus, would waste less of the total optical power. Thus, in contrast to the above-cited statement from the Office Action, Paiella's Figs. 3a and 3b would have suggested that gain-switched modulation of QC lasers was less power efficient than external output modulation. Such a teaching would not have motivated one of skill in the art to modify Christopher's system to incorporate Paiella's gain-switched QC laser system therein.

Thus, the Office Action does not provide a prior art teaching to support the asserted motivations to modify Christopher to incorporate Paiella's teachings on gain-switched system therein as needed in a proper case of prima facie obviousness.

Similarly, the Office Action does not provide a prior art suggestion to motivate modifying Christopher to incorporates Sell's teachings therein as needed in a proper case of prima facie obviousness. In particular, the Office Action states:

> One of ordinary skill in the art would have been motivated to combine the teaching of Salter [sic] et al. with the modified free space communication system of Christopher and Paiella et al. because the circuit of Sell maintains DC bias for the laser to keep the operation near and below lasing threshold and operates with real application of data signals.

Office Action, page 3, first full paragraph.

In contrast to the Office Action's statements, there would have been no advantage to operate Christopher's optical transmission laser near and <u>below</u> the lasing threshold. In

particular, the Office Action admits that Christopher does not teach gain-switched operation. In the absence of gain-switching, the laser is typically maintained in the ON-state during transmission, i.e., above the lasing threshold. Thus, operating Christopher's laser below the lasing threshold would not have seemed to be an advantage. Second, at page 3, first full paragraph, the Office Action states that Sell's teaching of "operat[ing] with real application data signals" also motivates using Sell's teachings to modify Christopher. In contrast, Applicants note that the title " ... Communication for Satellite-Ground or Air-Ground Links" of Christopher's '643 provisional application already suggested application of data signals to a carrier. Thus, such a teaching from Sell would not have motivated modifying the system of Christopher. Thus, the Office Action does not provide a prior art suggestion to modify Christopher with teachings of Sell as needed in a proper case of prima facie obviousness.

Indeed, the Office Action has used impermissible hindsight rather than providing a prior art teaching to motivate modifying Christopher to incorporate teachings of Paiella and Sell therein. For these reasons, the obviousness rejections of claims 1 – 2, 4 – 10 and 13 – 19 are improper and should be withdrawn.

2. At pages 4 and 5, the Office Action rejects claims 3, 11 - 12 and 20 – 22 as obvious over a combination of Christopher, Paiella, Sell, and Hwang.

Claims 3, 11 - 12 and 20 – 22 are non-obvious at least by their dependence on a non-obvious base claim, i.e., claim 1 or 13.

CONCLUSION

Applicants respectfully request allowance of pending claims 1 – 22.

NO FEE

In the event of any non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Lucent Technologies Deposit Account No. 12-2325** to correct the error.

Respectfully,

By John McCabe

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